Testing Geant4 production threshold cut for shower simulation in EMCal
and
Verifying default Step Length for a large scintillator Box

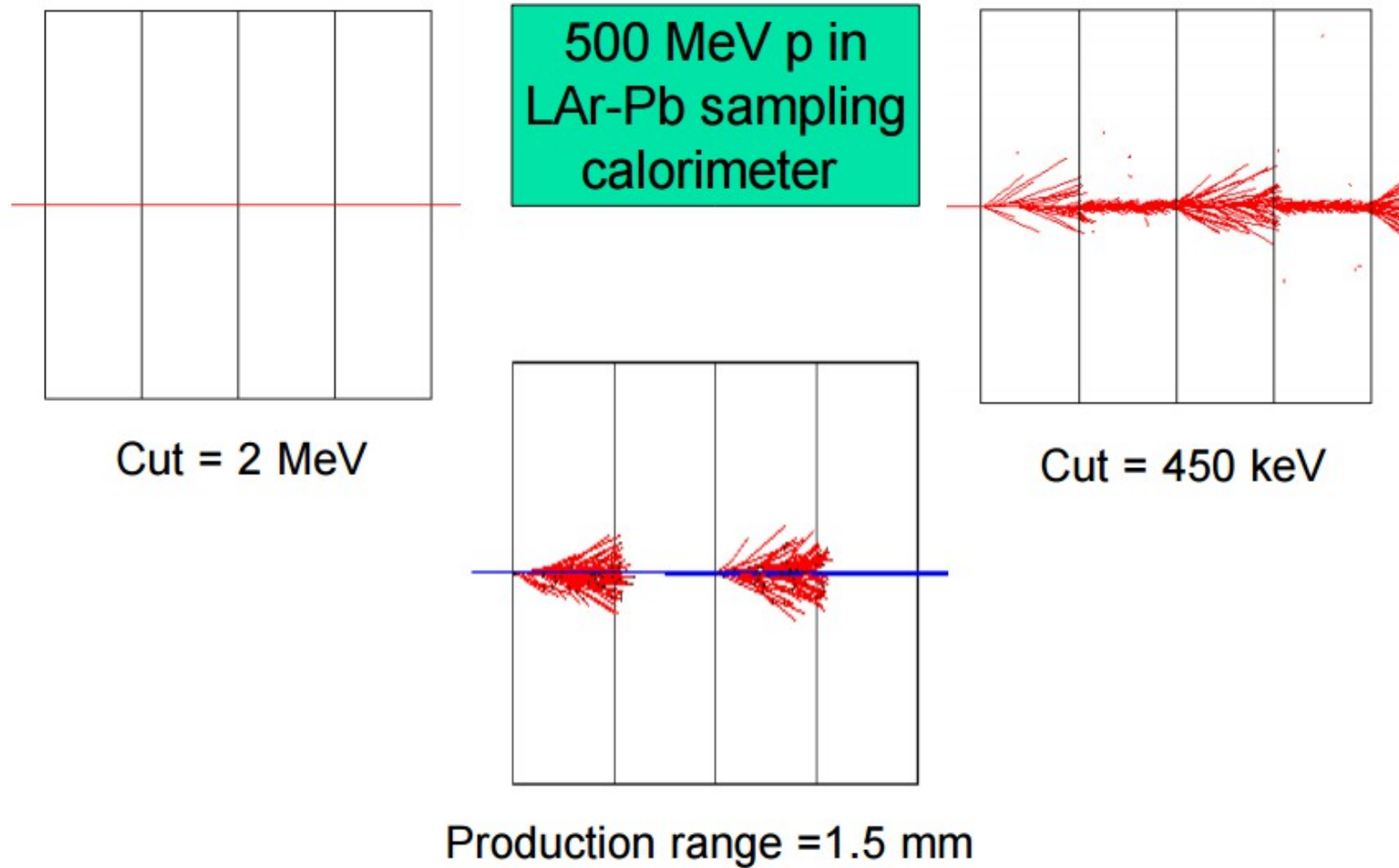Eliton Popovicz Seidel

Baruch College

Production Threshold

- We can impose a production threshold (which is a distance).

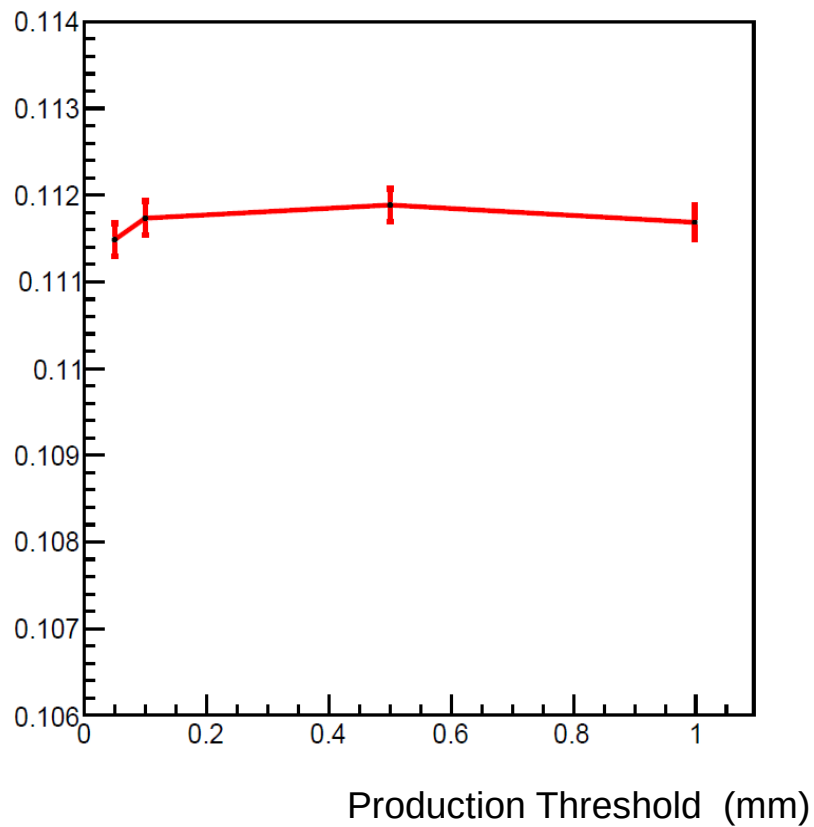- Geant4 default: 1 mm.

How does this work?

- Primary Particle loses energy by producing secondary particles.

- If the primary particle no longer has enough energy to produce secondaries which travel at least 1 mm, two things happen:
  - No more secondary particles produced.
  - The primary is tracked down to zero energy using continuous energy loss.

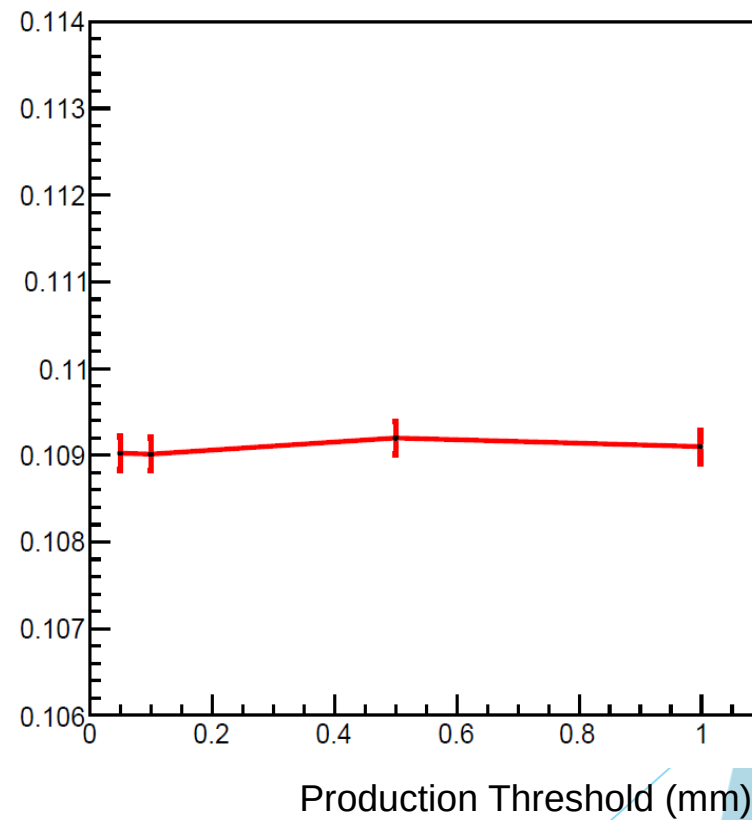# Production Threshold vs. Energy Cut

500 MeV p in LAr-Pb sampling calorimeter

Cut = 2 MeV

Production range =1.5 mm

Cut = 450 keV

SLAC Geant4 Tutorial by Dennis Wright
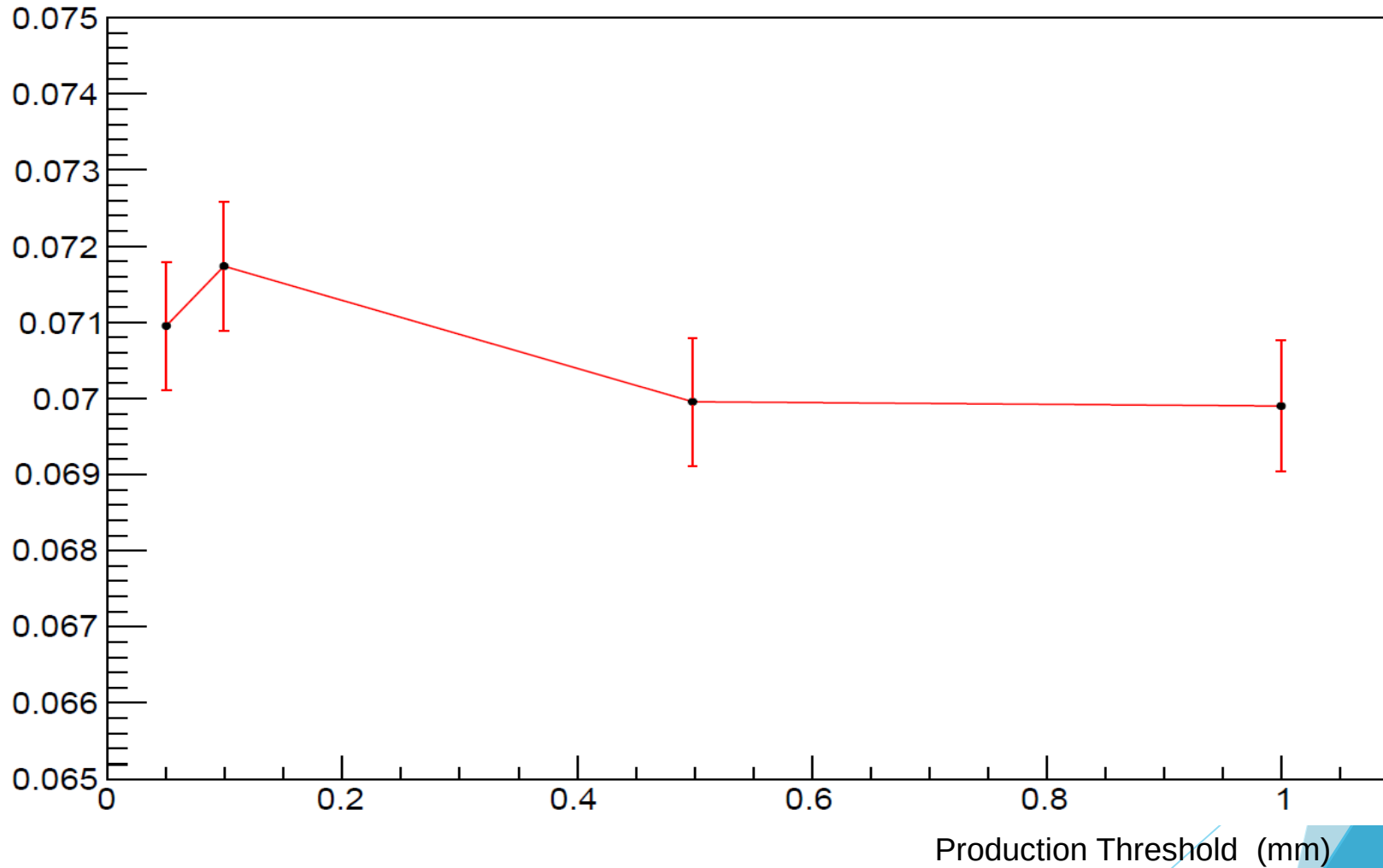
Gaussian Mean vs. Production Threshold

Energy Deposition Mean

Ligth Yield Mean

# Ratio of Pions that passed the cut of 80% of Light Yield by Electrons

Conclusion

- The plot from previous slides show us that there is no obvious dependency on Production Threshold.

- Need to check energy resolution VS threshold too.

- If not large dependence, we plan to keep Geant4 default value now

- Next to study: final range cut

- Suggestion welcomed.

Step Length for a scintillator Box
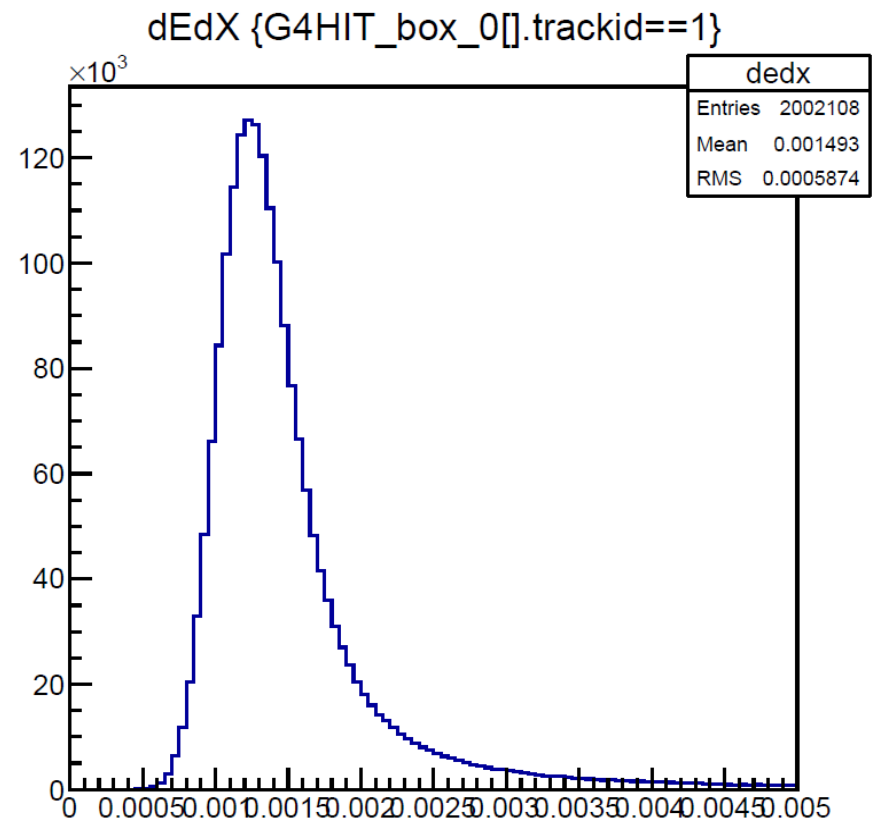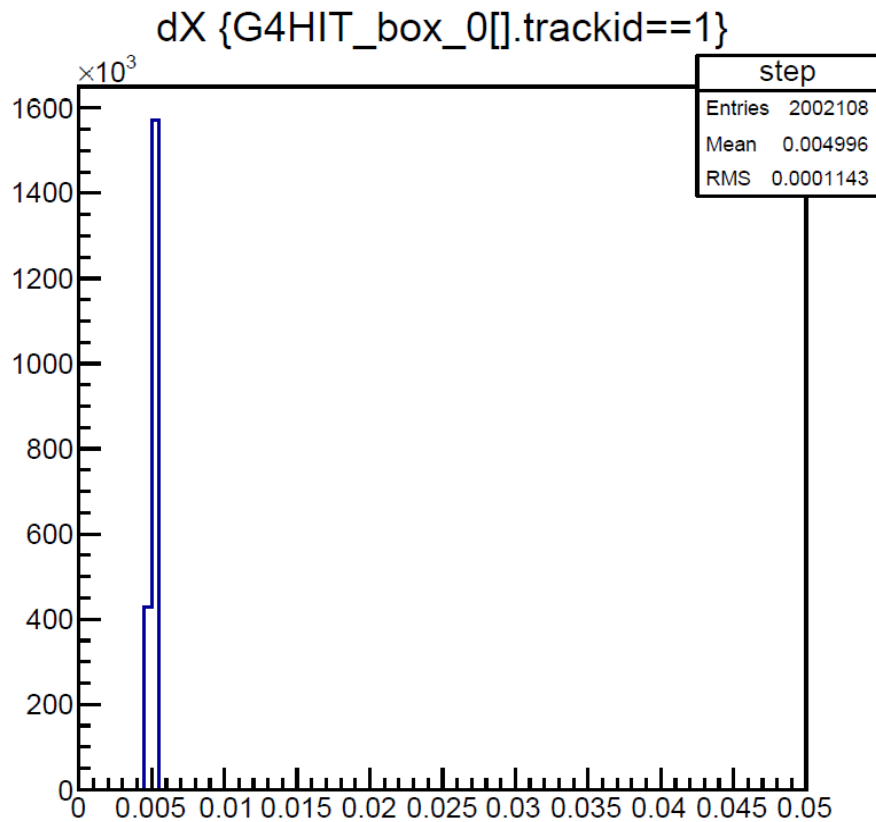
Without Step Limiter
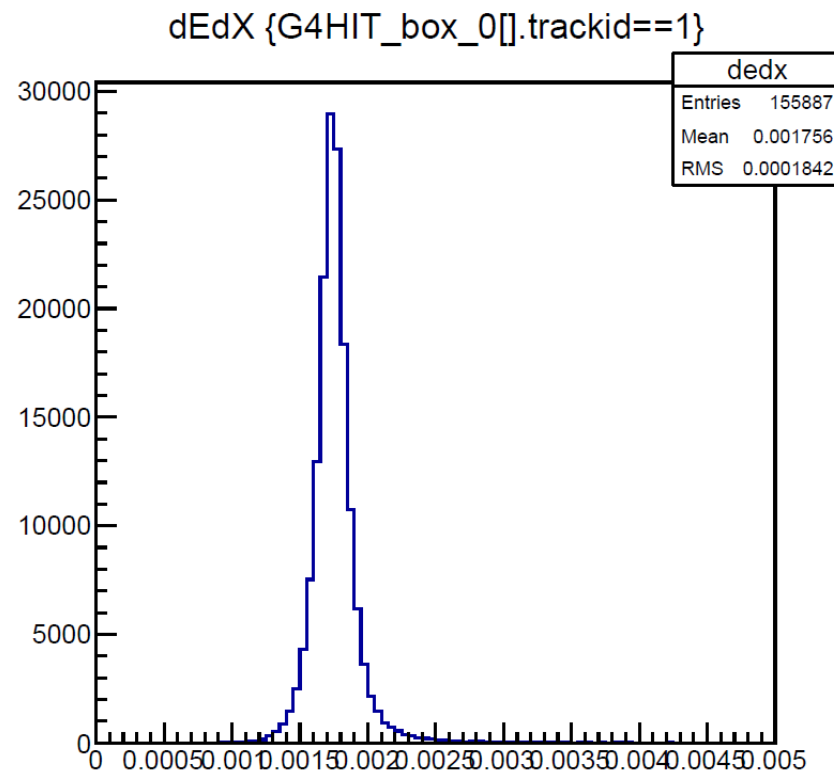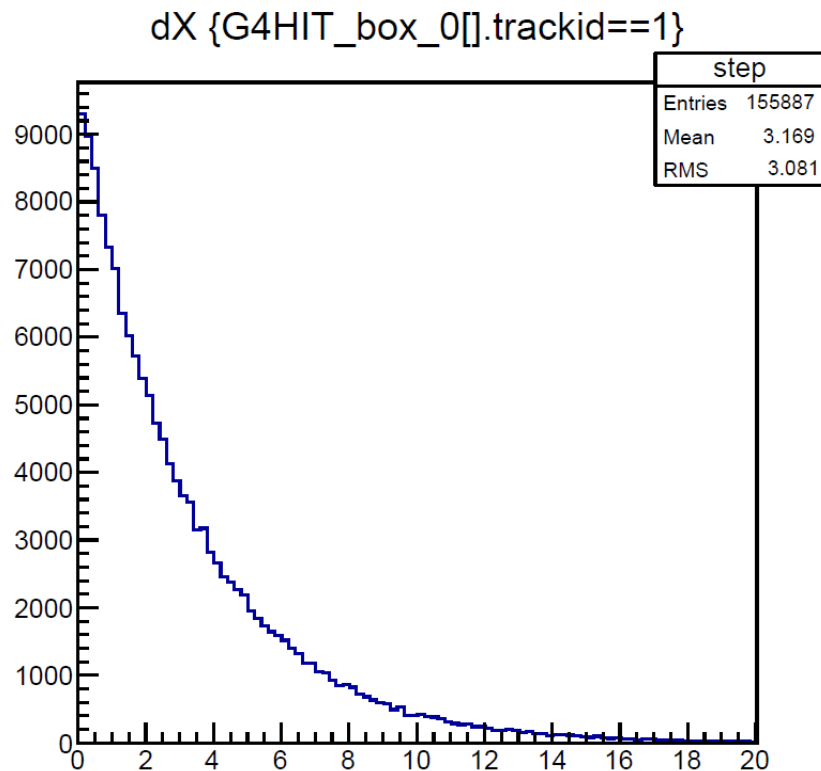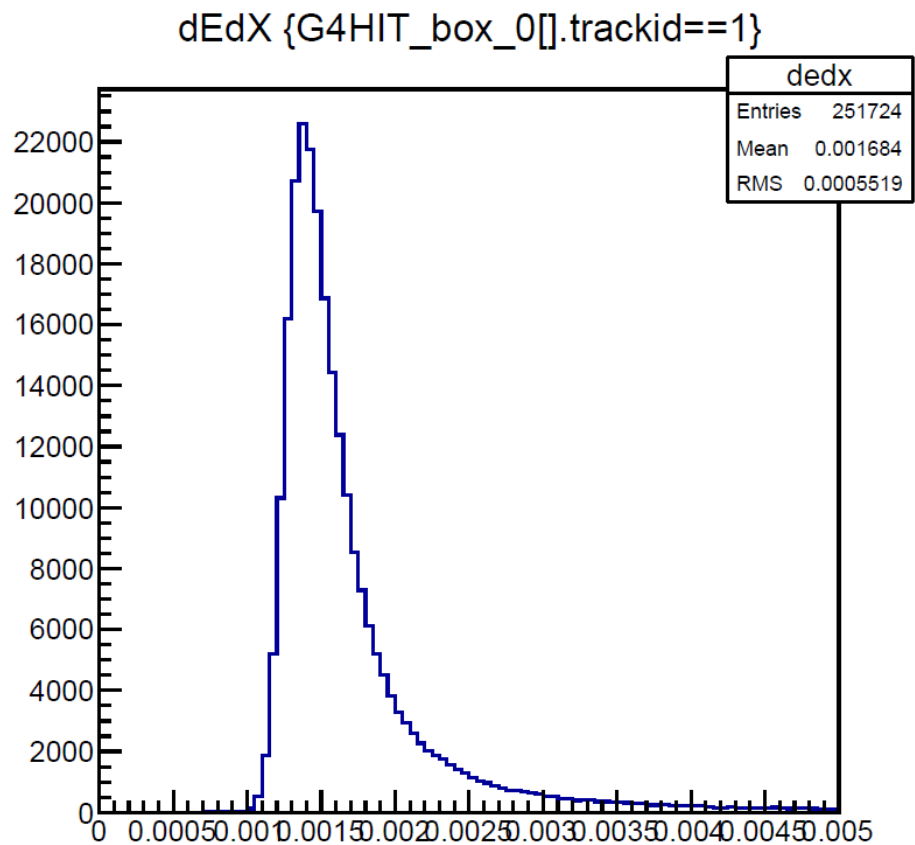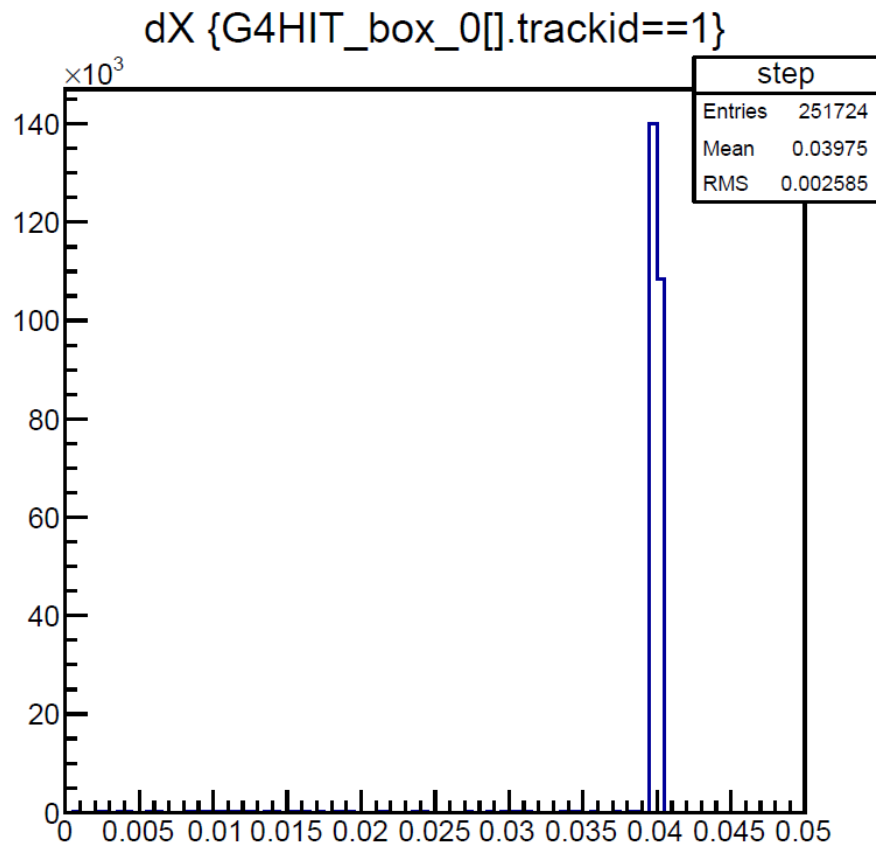

Particle: Muon
Energy : 4 GeV

Conclusion

- Geant4 default prefer to use much larger step length for muons

- In SPACAL, step length is limited by fiber size to mm-level, which would translate to different sensitivity to Birks effect through dE/dx fluctuation

Checking Step Limiter – 50 micrometer

Checking Step Limiter – 400 micrometer

Default Geant4 Step Length - Spacal